

# 47 Years After *Limits to Growth*

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# Five Questions

- What research did we do 47 years ago?
- What did we forecast in 1972?
- How accurate were our scenarios?
- What research would we do today?
- What do we forecast in 2019?

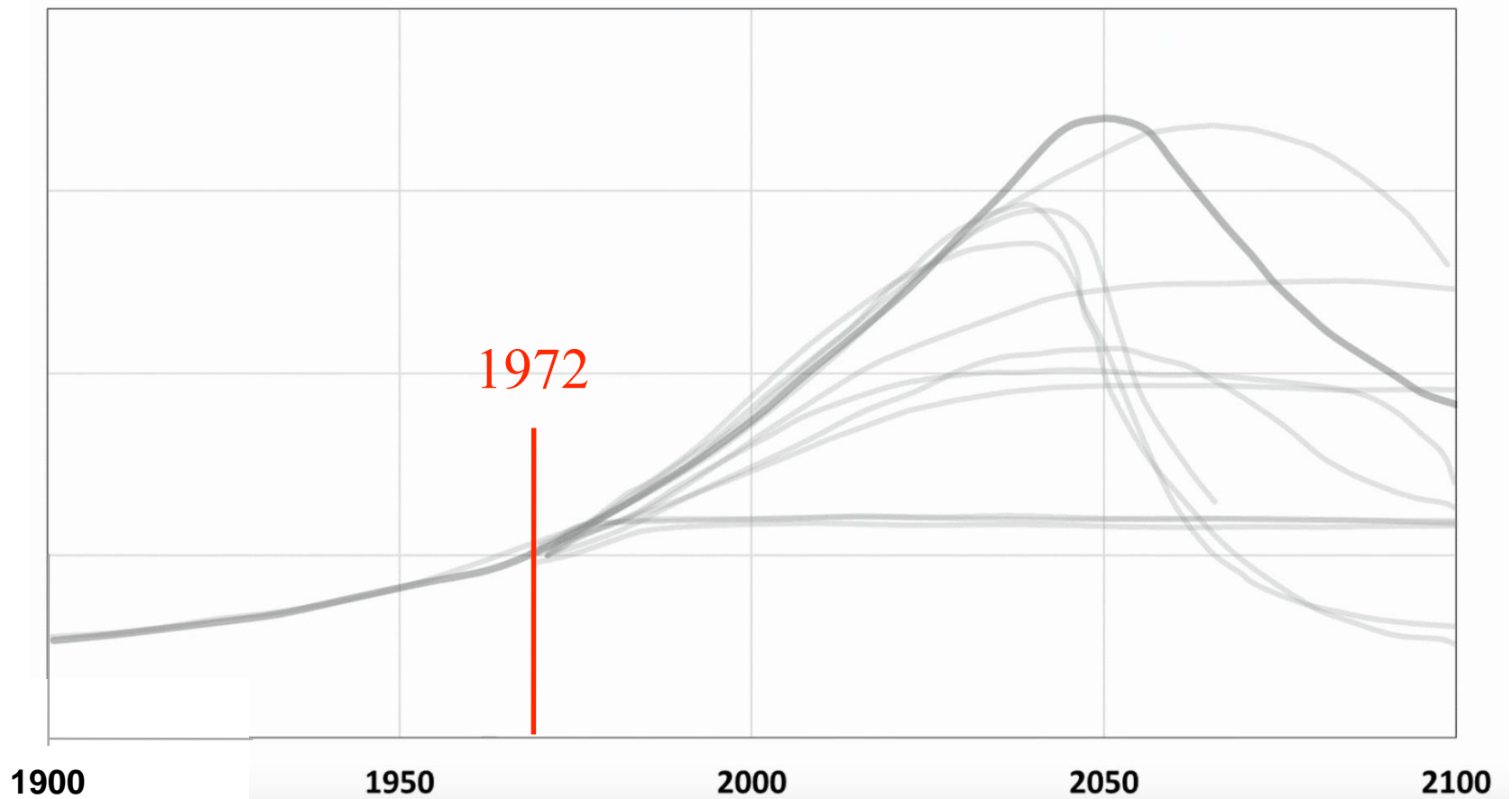
# Exercise

What research did we do 47  
years ago?

- Prof. Jay Forrester developed a simple, theoretical, global computer model.
- At MIT I assembled and directed a team of 17 analysts to gather actual data and change the model to reflect current science.
- For 18 months we refined the computer model, and wrote 3 reports to the Club of Rome.

- We did not make predictions.
- We generated a scenario using the best available data: 1900-2100.
- Then we tested the impact of 11 different sets of assumptions about changes in starting assumptions and technological change.
- We focused on five main variables - population, food, industrial production, resources, pollution.

# The 12 Scenarios for Population



What did we forecast in 1972?

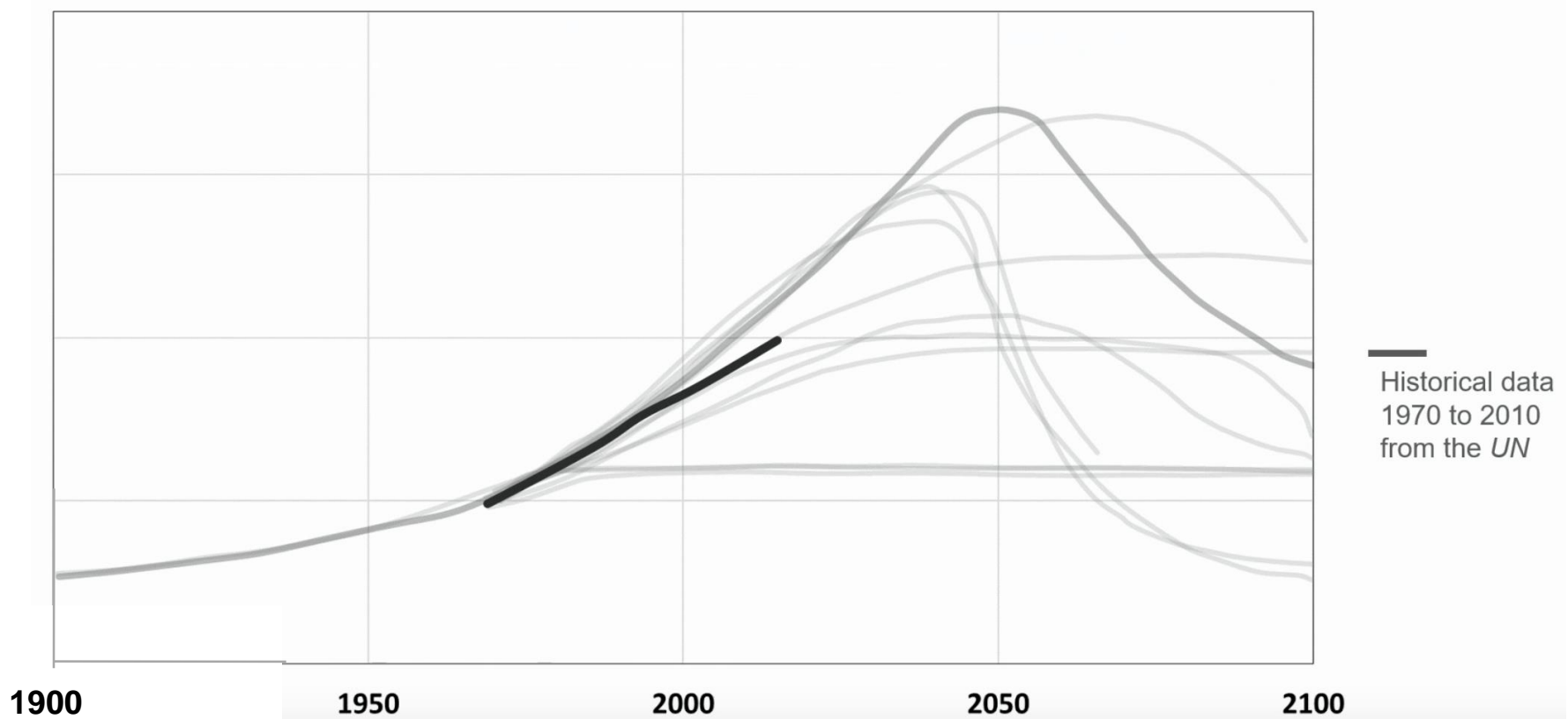


# Main Insights from the Scenarios

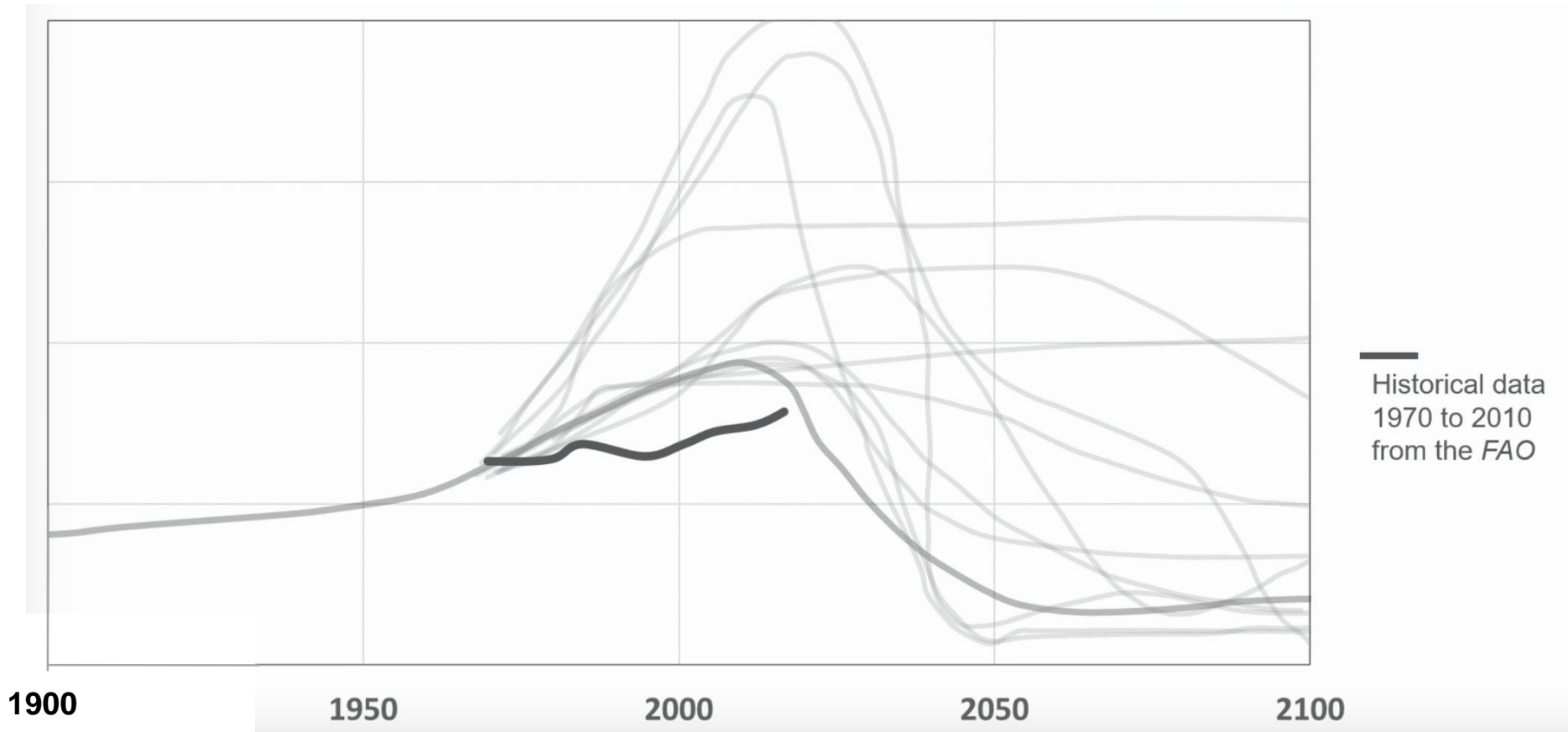
- In 1972 we projected another 40-80 years of growth; All our scenarios showed growth ending in the period 2010-2050.
- The most common behavior pattern was overshoot and decline, not gradual slowing within a limit.
- Technology advance did delay the end of growth by a few years, but not eliminate it, and it did **not** avoid the decline.
- Social and economic changes were required to attain the most attractive futures.
- Today's "problems" are not actually problems; they are symptoms. The real problem is physical growth in material and energy flows pressing against the limits of a finite planet.

How accurate were our  
scenarios?

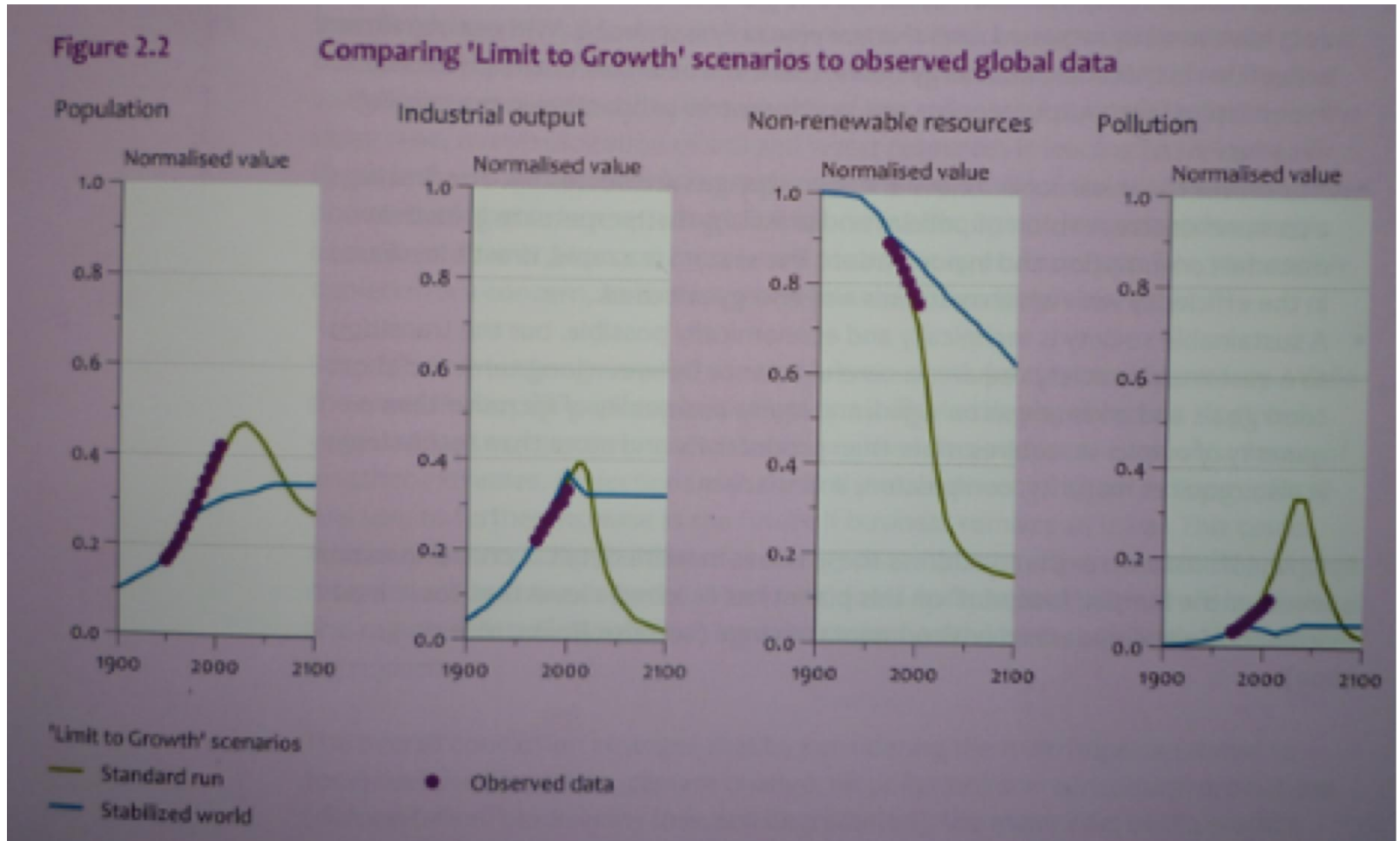
# Population - Scenarios & Data



# Food Per Person - Scenarios & Data



# CSIRO Study



From: *Growing within Limits*, Netherlands Environmental Assessment Agency, October 2009, page 23.

What research  
would we do today?

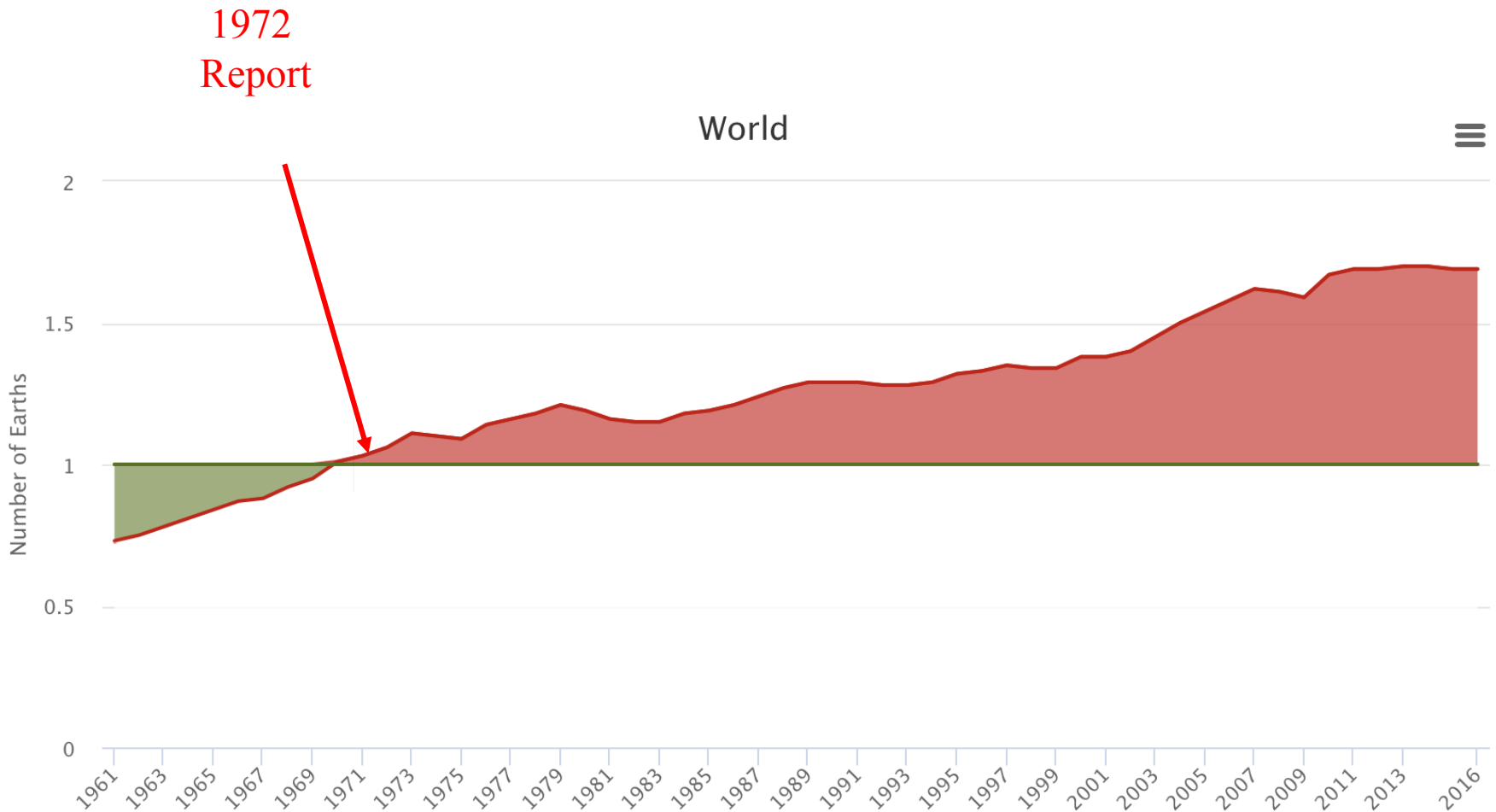
# Potential Changes

- Separate energy from the other resources.
- Separate CO<sub>2</sub> from other persistent pollutants.
- Include the military as a separate category of capital.
- Would **not** distinguish among countries.
- Would **not** introduce prices.
- Would **not** make technology autonomous.

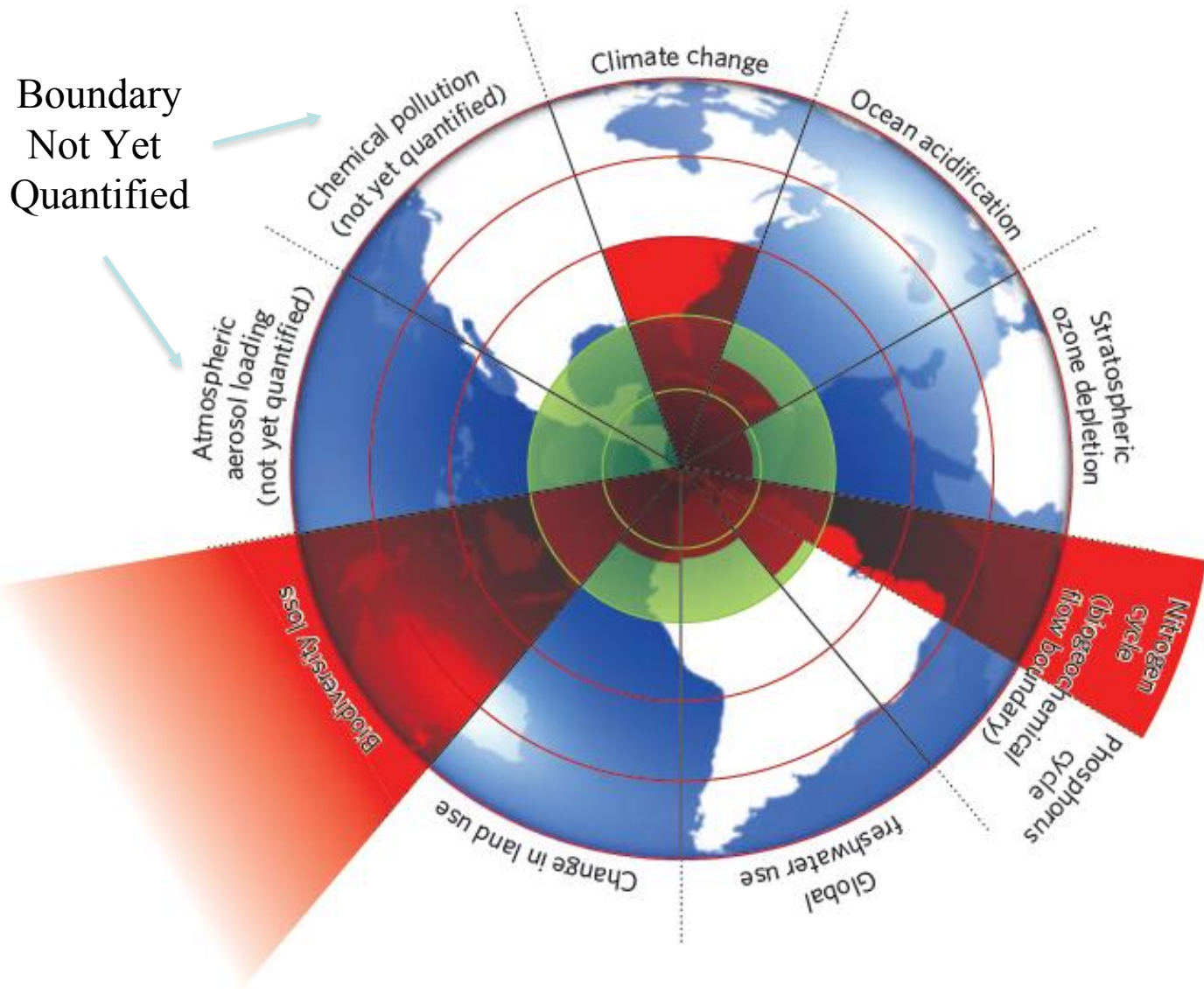
These changes would not raise the limits on physical growth nor avoid overshoot!



# Overshoot is a Fact



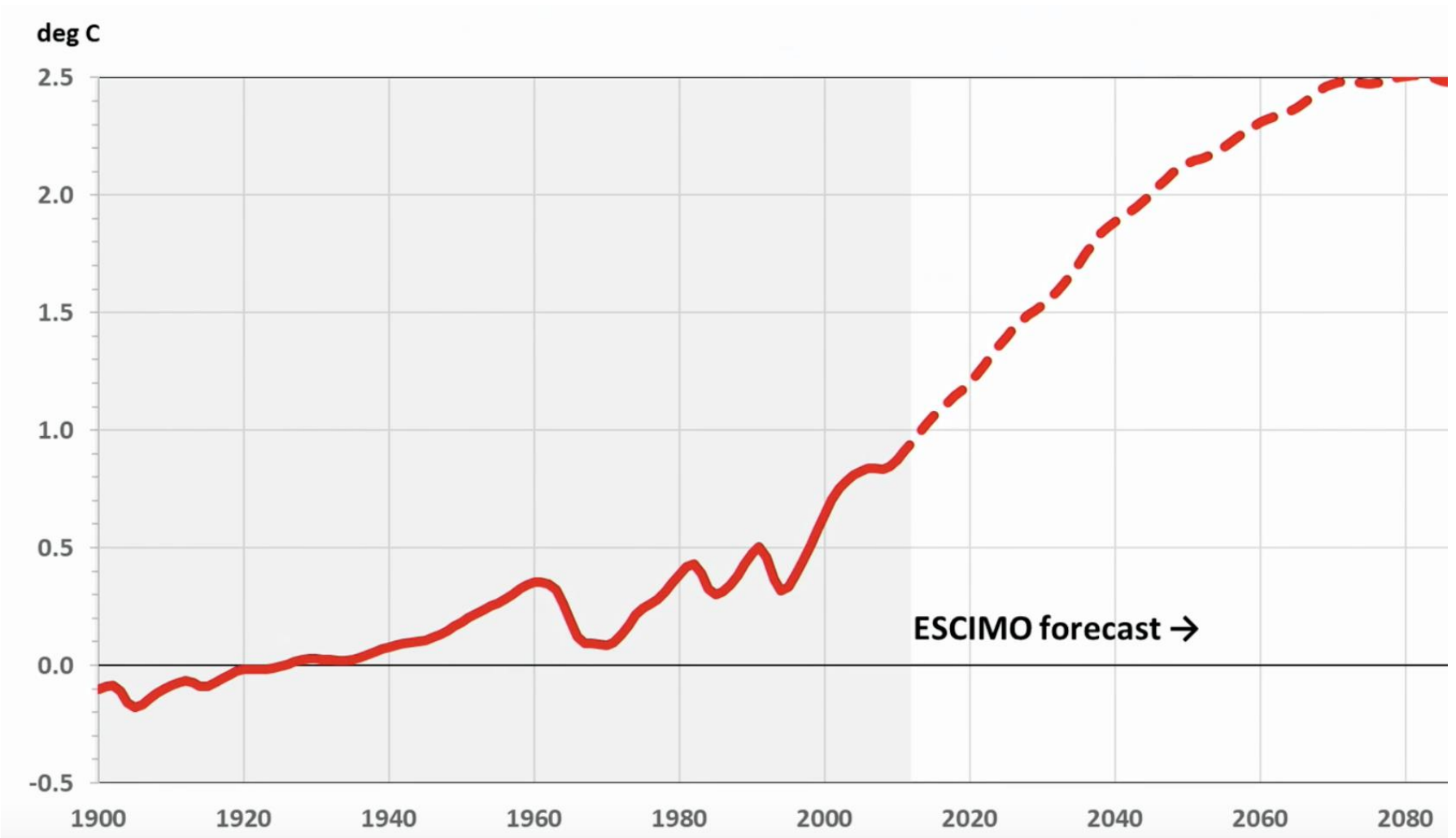
# Other Indicators of Overshoot



# What do we forecast in 2019?

1. There is no possibility to avoid more severe climate change

# One Temperature Forecast



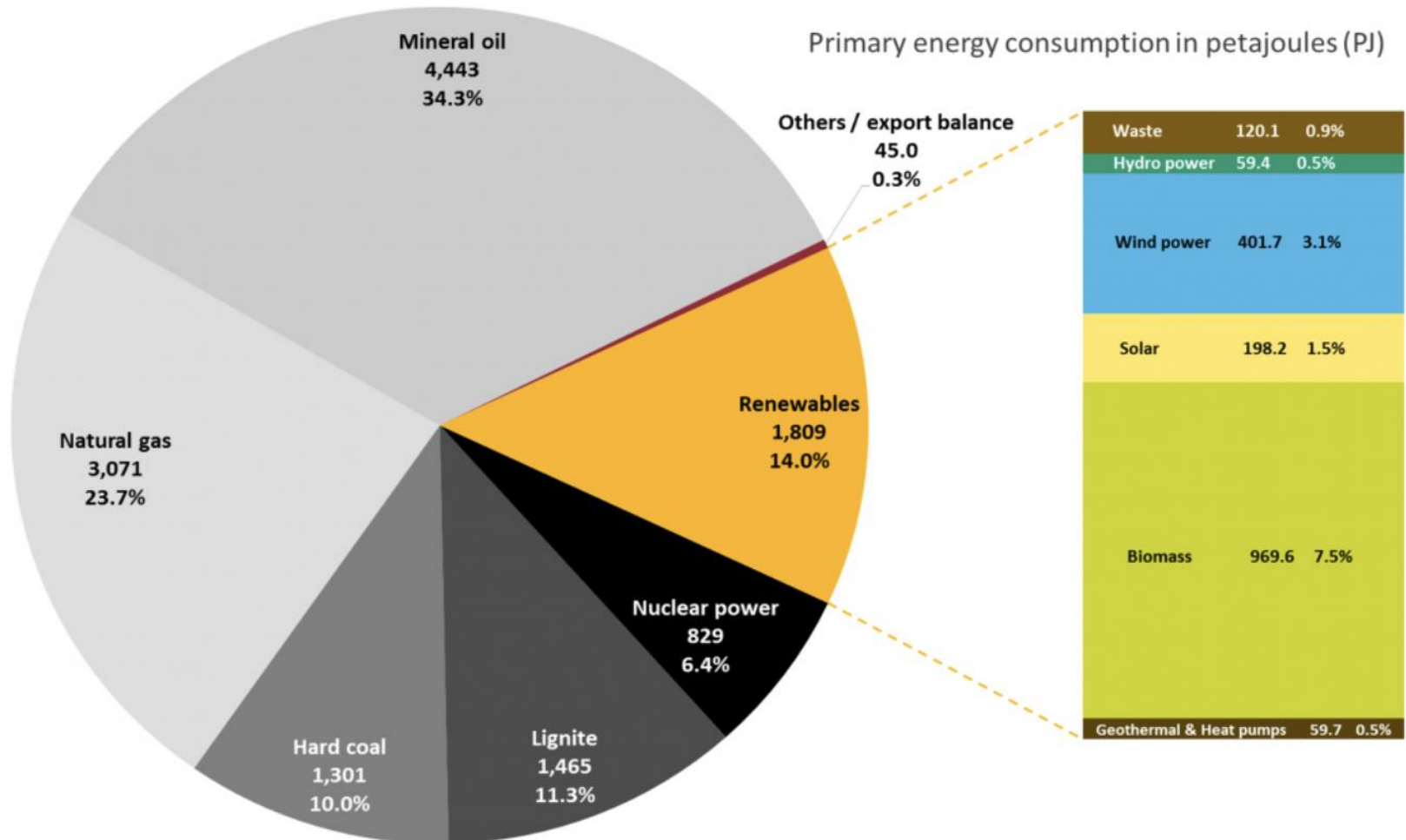
# Some Impacts on Germany

- More frequent heat waves
- Rising sea level
- More extreme weather - droughts, floods, and winds
- Declining food production and nutrition
- Simplifying biosphere - more pests
- More expensive energy
- Growing migration pressure

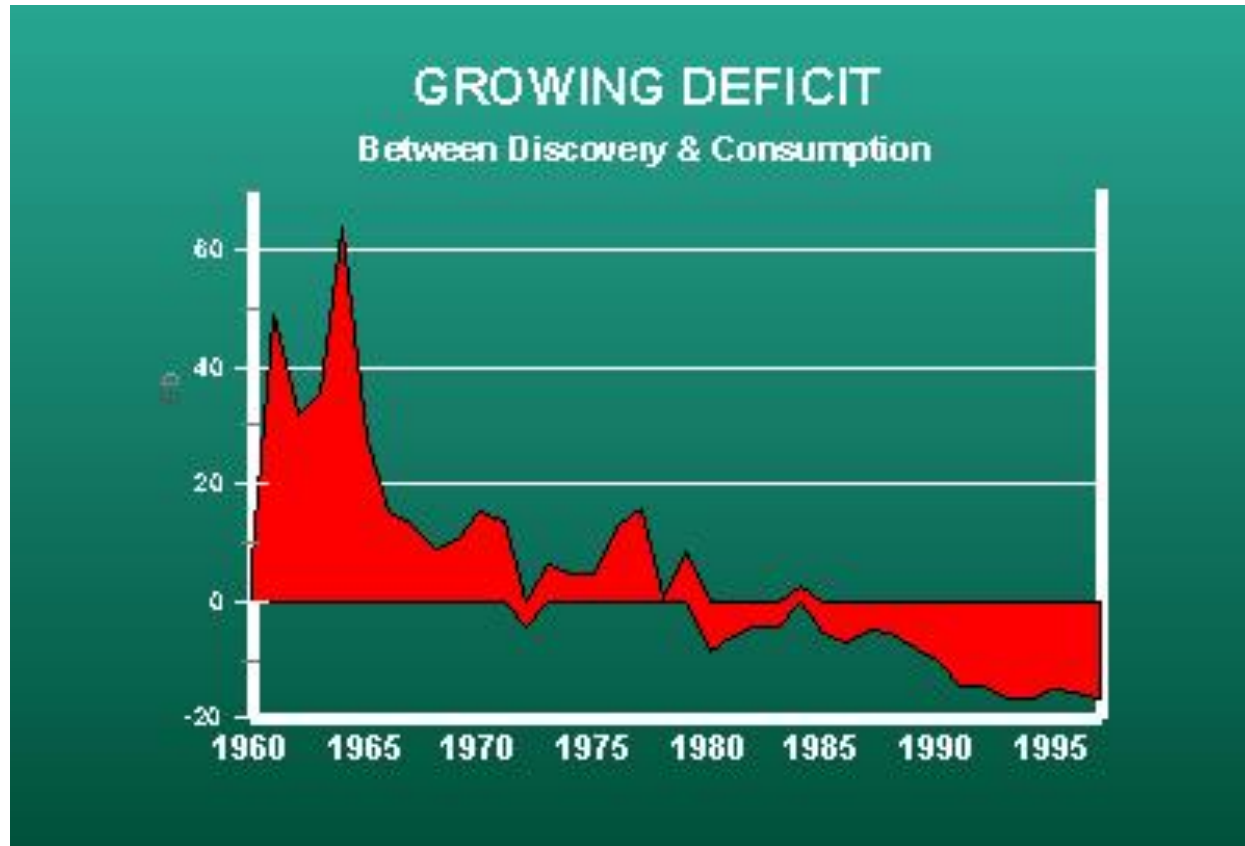
# What do we forecast in 2019?

1. There is no possibility to avoid more severe climate change.
2. Energy will soon become much more expensive.

# Germany's 2018 Energy Use

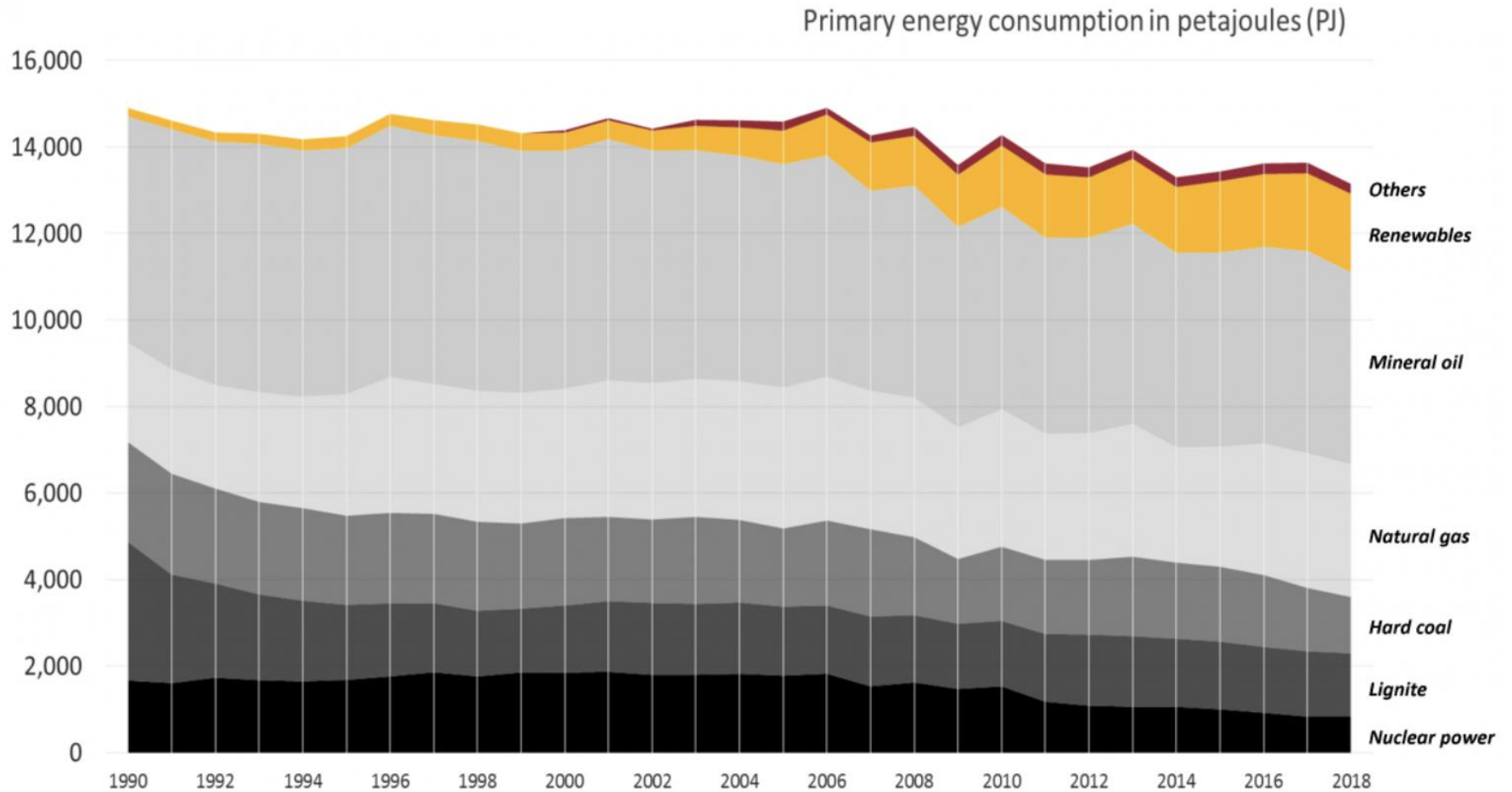


# Gap between Discovery and Use





# Germany's Energy Use 1990 -2018



# Impacts on Germany

- Rising political power of energy exporters versus energy importers
- Slowing economic growth
- Rising prices for food, goods, and services
- Domestic political change
- Changing structure of labor force

# The Challenge of Man's Future

Within a period of time which is very short compared with the total span of human history, supplies of fossil fuels will almost certainly be exhausted. This loss will make man completely dependent upon waterpower, atomic energy, and solar energy for driving his machines. ....it is a transition that will happen only once during the lifetime of the human species. .. if machine civilization should, because of some catastrophe, stop functioning, it will probably never again come into existence.

Harrison Brown, 1954, p.222

# The Time of Greatest Stress

- Most people assume that the major global difficulties would occur after the end to growth.
- This is not correct.
- The globe's population would experience the most stress prior to the peak, as pressures mount high enough to neutralize the enormous political, demographic, and economic forces that now promote growth.
- We are in the early phases of that period now; you will experience more change over the next 20 years than occurred during the past 100 years.

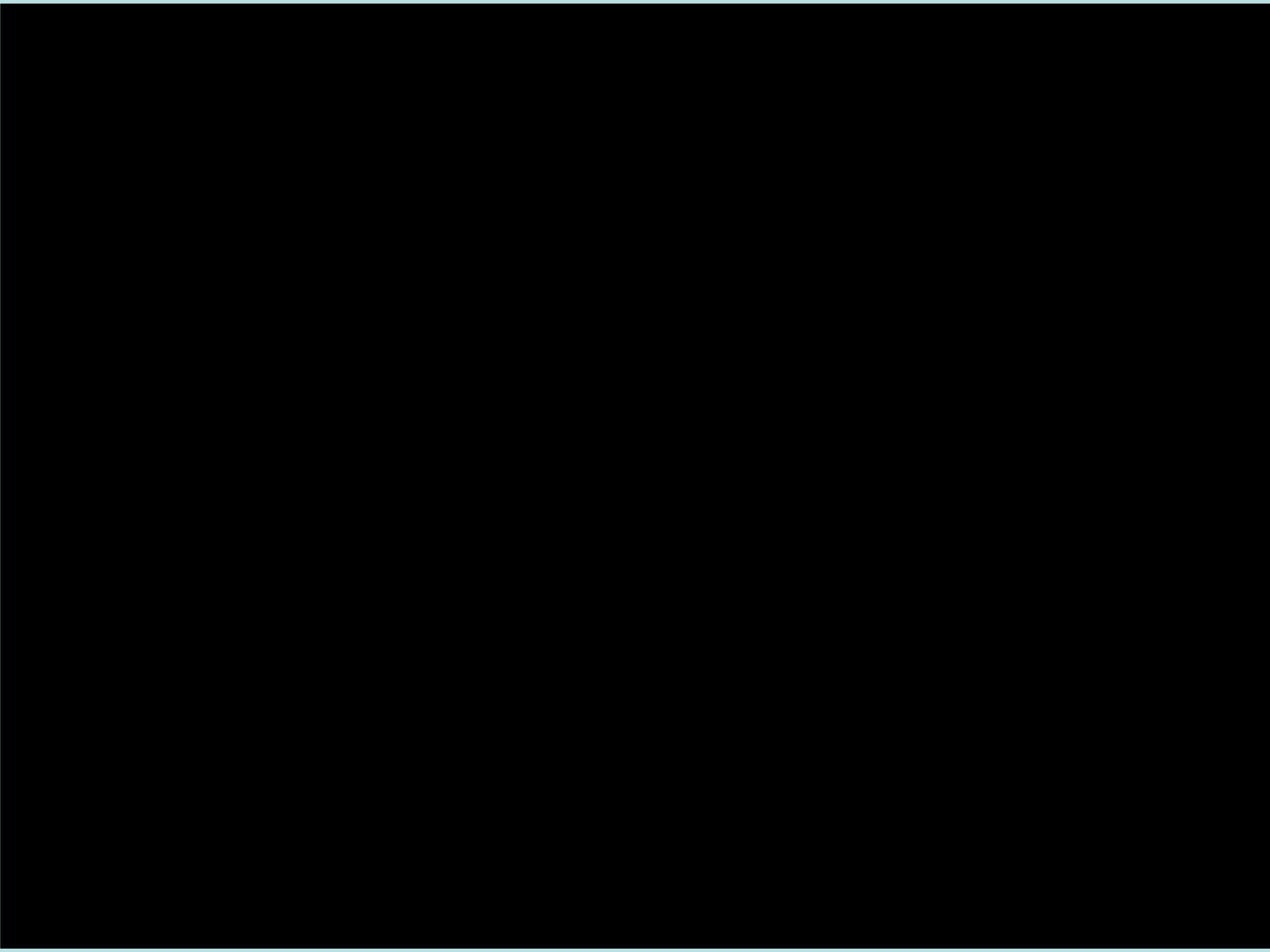
# Principles for action - 1

- Recognize that until physical growth is halted on this planet, there is no possibility of avoiding ever rising problems.
- Develop the government, corporate, and cultural capacity for sustained long-term action, even when the necessary solutions make the of short-term problems seem worse. Remember you do not have to develop these changes within precisely the current system; as that will change anyway.
- Expect the present market system to magnify problems, not avoid them.
- Remember there are enormous delays between action and response; so take action “before it is obviously needed.”
- Social and cultural policies will give better results than economic and technical policies. Focus on getting enough rather than on getting more.

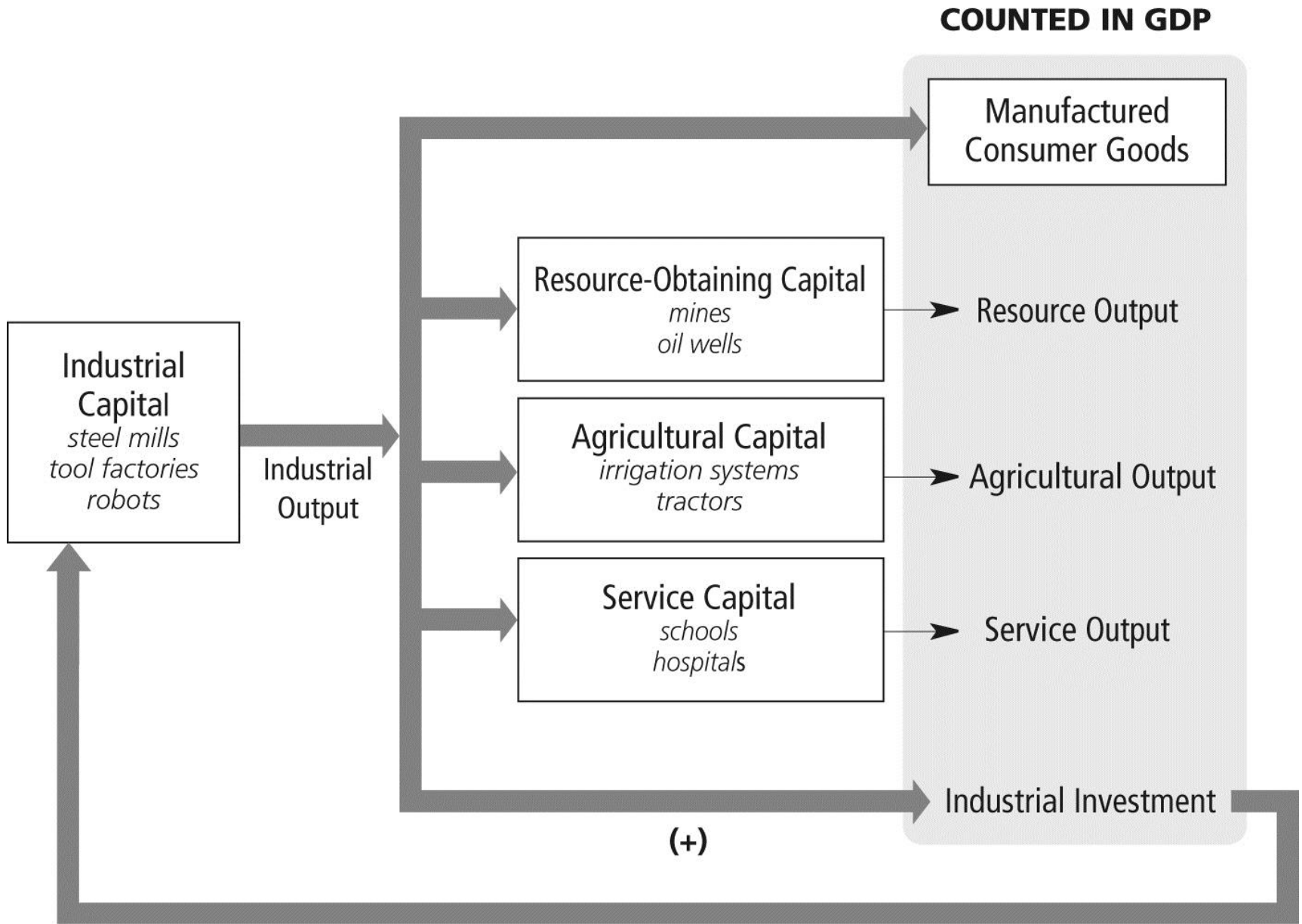
# Principles for action - 2

- Do not use economic discounting methods to find solutions for problems that produce irreversible results
- Expect problems to appear suddenly and in combination.
- Realize that no one fully understands these systems.
- Realize that government will be overloaded and will make mistakes.
- Forget about going back to the past conditions.
- Research and invest to increase resilience.

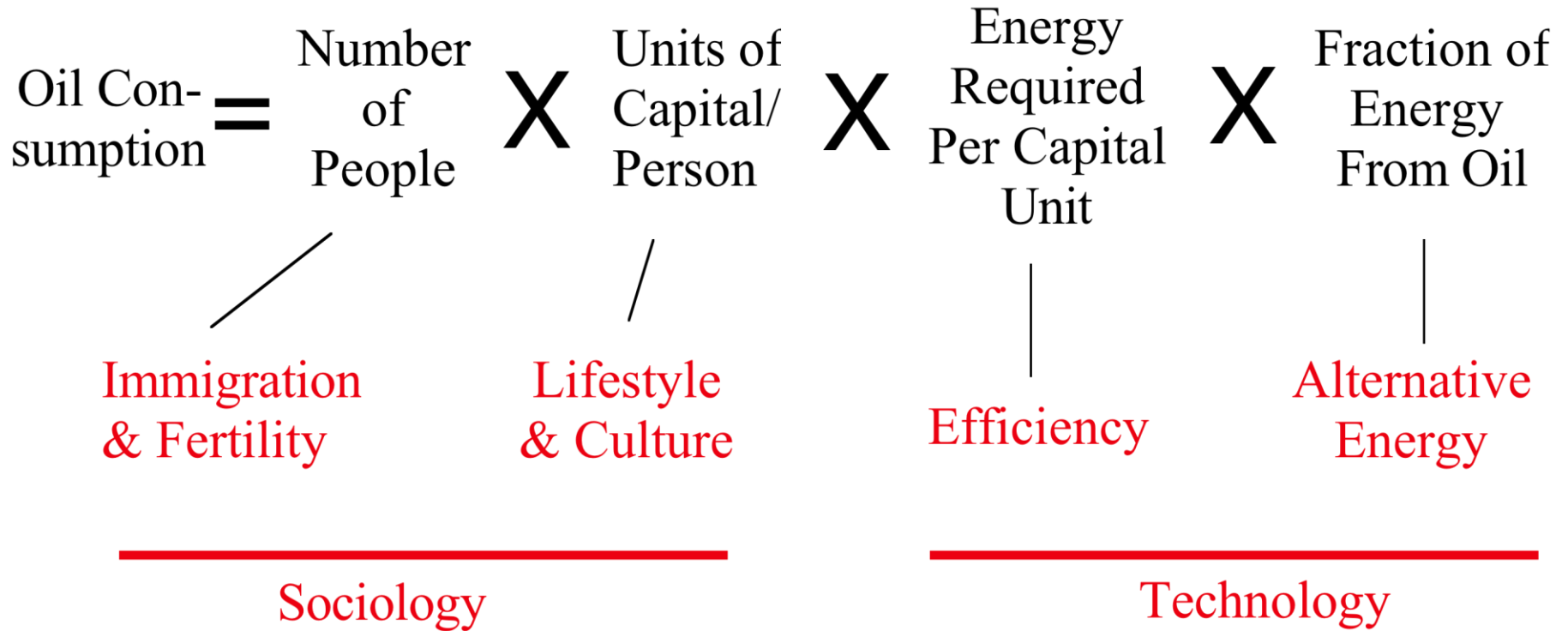
# Exercise



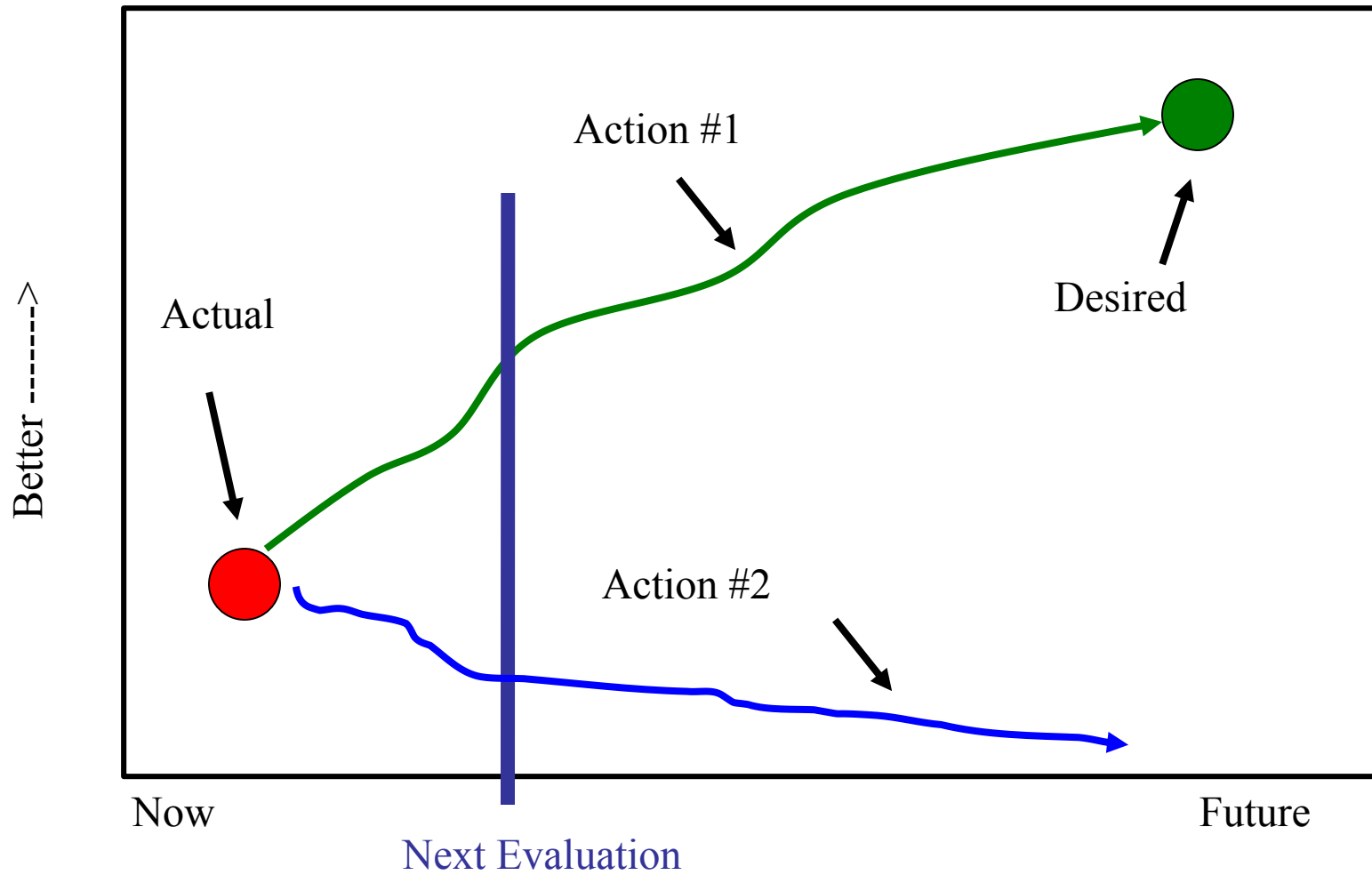




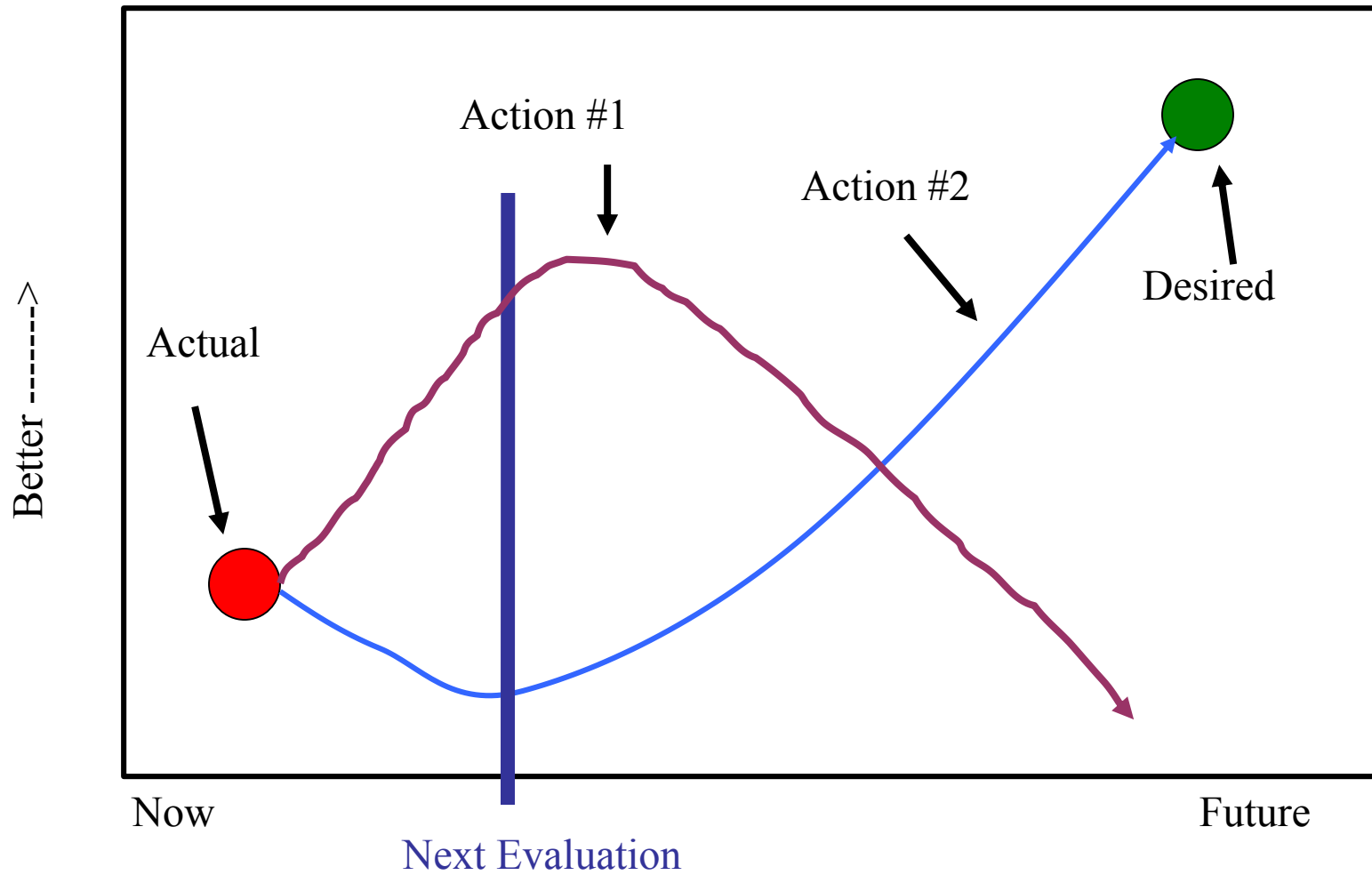
# Four Factors Determine the Amount of Oil Consumption



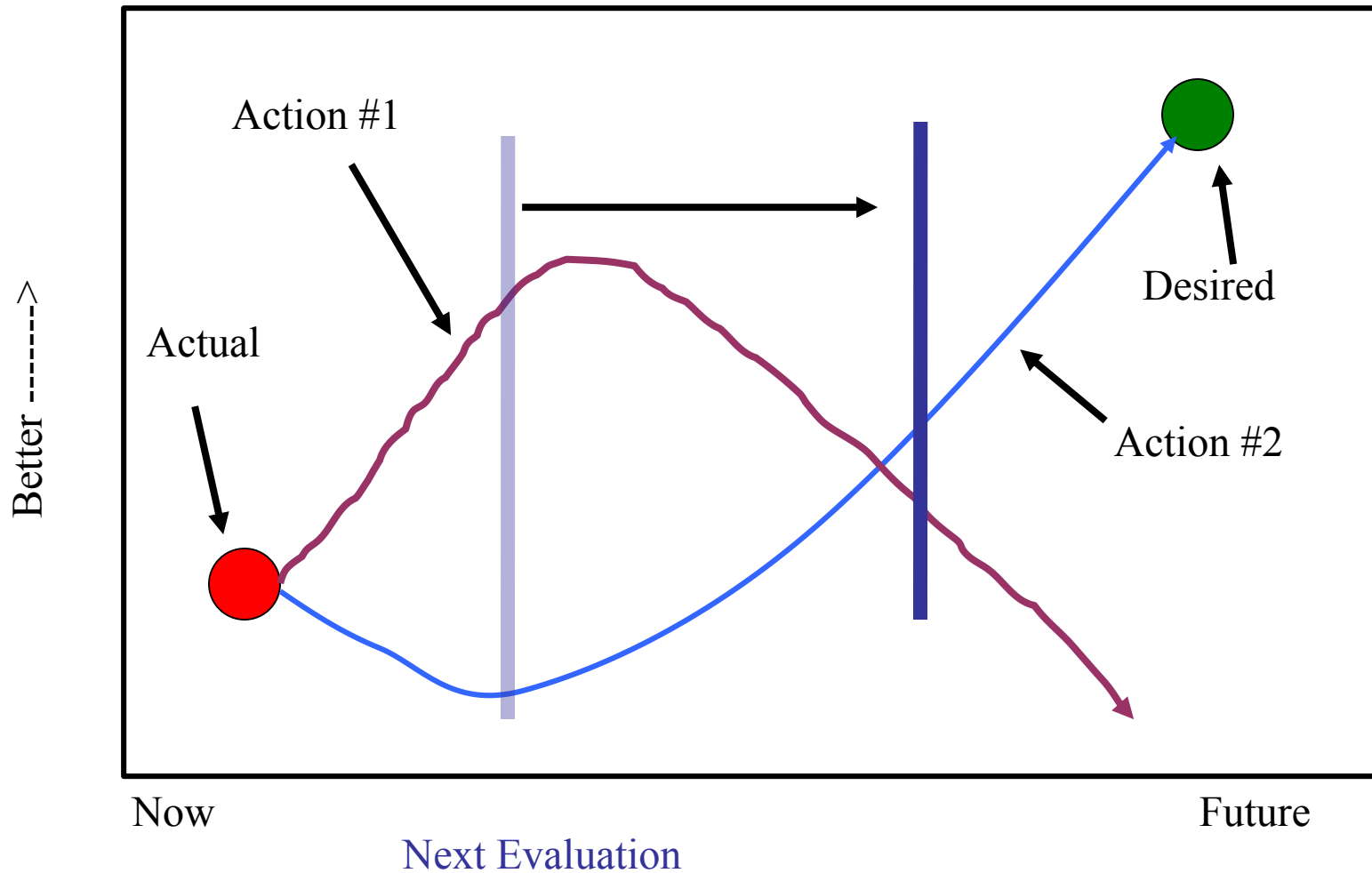
# Easy Problems



# Difficult Problems



# Difficult Problems Become Easy with Greater Time Horizon



# Governance

- Most current political and market systems are quite effective at solving Easy Problems.
- Most current political and market systems are not solving the Difficult Problems.
- Unfortunately for us, climate change and fossil fuel depletion are Difficult Problems.
- We need to amend our governance systems, so that they can pursue effective solutions that cause short-term difficulties for voters and consumers.